

Dual-polarimetric radar-based tornado debris signatures and paths associated with tornadoes over Northern Alabama during the historic outbreak of 27 April 2011

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A historic tornado and severe weather outbreak devastated much of the southeastern United States between 25 and 28 April 2011. On 27 April 2011, northern Alabama was particularly hard hit by 40 tornadoes, including 6 that reached EF-4 to EF-5 on the Enhanced Fujita damage scale. In northern Alabama alone, there were approximately 100 fatalities and hundreds of people who were injured or lost their homes during the havoc caused by these violent tornadic storms.

Many of these tornadoes occurred within range of the University of Alabama in Huntsville (UAHuntsville) Advanced Radar for Meteorological and Operational Research (ARMOR, C-band dual-polarimetric). A unique capability of dual-polarimetric radar is the near-real time identification of lofted debris associated with ongoing tornadoes. The focus of this paper is to analyze the dual-polarimetric radar-inferred tornado debris signatures in 6 tornadoes in North Alabama on April 27, 2011. Several of these debris signatures were disseminated in real-time to the NWS Huntsville and local media to confirm storm spotter reports, confidence to enhance wording within warnings, and accurately pinpoint the locations of tornadoes for residents downstream of the storm. Also, the debris signature locations were used in post-event storm surveys to help locate areas of damage in regions where damage went unreported, or to help separate tornado tracks that were in close proximity to each other.

Furthermore, the relative locations of the debris and damage paths for long track EF-4 and EF-5 tornadoes will be ascertained by careful comparison of the ARMOR analysis with NASA MODIS (Moderate Resolution Imaging Spectroradiometer) and ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) satellite imagery of the tornado damage scenes and the National Weather Service tornado damage surveys.

With the ongoing upgrade of the WSR-88D (Weather Surveillance Radar – 1988 Doppler) operational network to dual-polarimetry and a similar process having already taken place or is ongoing for many private sector radars, dual-polarimetric radar signatures of tornado debris promise the potential to assist in the situational awareness of government and private sector forecasters and emergency management personnel during tornadic events.